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NORTH AMERICAN TRICLAD TURBELLARIA, XIII: THREE NEW CAVE PLANARIANS

By Libbie H. Hyman

Previously (Hyman, 1937, 1939, 1945) I have described a total of 11 species of planarians from the waters of North American caves. Comment was made in these articles on the extensive speciation exhibited by the cave planarians of the United States. It was pointed out that every locality appears to have a different species of cave planarian and that the investigation of caves in new localities inevitably reveals new species of these animals. The present report is based on collections from caves in three new localities and each locality is again found to harbor a new and different species of cave planarian. As generic and familial definitions have been presented in my previous articles on cave planarians, it appears unnecessary to repeat them here.

Family Planariidae

Phagocata cavernicola, new species

Figure 65,*a–c*

Material.—Five specimens sent by the U. S. National Museum (USNM).

Form.—Small, slender, elongate (fig. 65, *a*), around 7 to 8 mm. long, probably up to 10 mm. in length; anterior end appears slightly rounded as in figure 65,*a* in some of the specimens, truncate or slightly indented in others (fig. 65, *b*).

Color.—White in life, according to the collector, but turns brown on preservation.

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Eyes.—Typically two, but two of the five specimens show supernumerary eyes as in figure 65, *a*, *b*; possibly this indicates a breakdown of the eyes in relation to the cave habitat.

General structure.—The histological condition of the specimens is poor and it is impossible to furnish details of the structure. The pharynx appears somewhat long for the size of the animal (fig. 65, *a*). In the median line of the head anterior to the eyes a light streak was noticeable on the whole animals (fig. 65, *a*) but one of the heads was sectioned sagittally and, although its histological condition is bad, it appears certain that the midregion does not differ histologically from the rest of the head. The body margins do not present any enlarged rhabdites.

Reproductive system.—Testes evident in the worms when whole and extend in lateral regions from the level of about the fourth intestinal diverticulum to the level of the gonopore (fig. 65, *a*). Transverse and sagittal sections show that the testes are situated ventrally. A sagittal view of the copulatory apparatus, constructed from two sets of sagittal sections, is shown in figure 65, *c*. The sperm ducts, ascending from below into the slightly developed penis bulb, enter separately the bulbar cavity. This is an oval cavity that makes a right-angled bend and continues through the penis papilla as the ejaculatory duct. The penis papilla has a short truncate form, and is noticeably lacking in muscularity. It is also asymmetrical, very decidedly so in one of the sagittal series; its dorsal wall is longer than the ventral wall. The penis papilla lies in a well-developed male antrum that narrows towards the common gonopore. Juxst before joining the vagina, the male antrum receives the common ovovitelline duct into its dorsal wall. The female canal shows an unusual degree of separation from the male antrum. There is, in fact, no development of a female antrum or common antrum as the vagina joins the male antrum almost at the gonopore. The vagina or terminal part of the female canal is somewhat expanded and lined by a very tall epithelium. The vagina is continuous with the bursal canal of which it is really the terminal portion. The bursal canal as usual is a narrow

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EXPLANATION OF FIGURES

1, eyes
2, intestinal diverticula
3, testes
4, pharynx
5, sperm ducts
6, penis bulb
7, penis papilla
8, ejaculatory duct
9, male antrum
10, vagina
11, copulatory bursa
12, bursal canal
13, entrance of ovovitelline duct
14, bulbar cavity
15, cavity of adhesive organ
16, eosinophilous lining of adhesive organ
17, retractor muscle of adhesive organ
18, adhesive organ
19, ovaries
20, margin of large rhabdites
21, adhesive tail region
22, eosinophilous gland cells
23, protractor muscle
24, gland areas of male apparatus
25, female antrum
26, common antrum
27, common gonopore

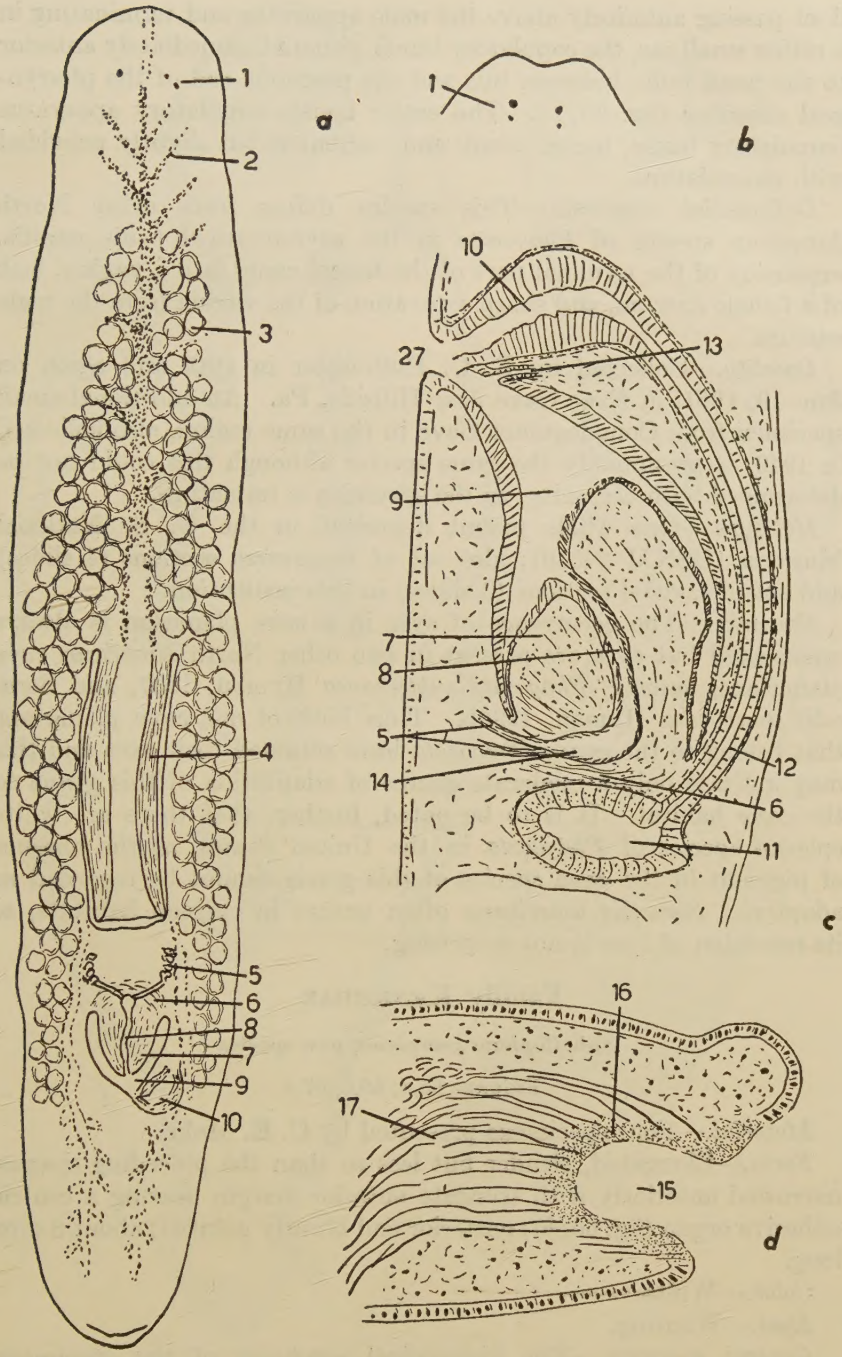

FIGURE 65.—*a*, General view of *Phagocata cavernicola; b*, anterior end of another specimen of *P. cavernicola*, showing supernumerary eyes; *c*, sagittal view of the copulatory apparatus of *P. cavernicola*, posterior end above; *d*, sagittal section of the adhesive organ of *Sphalloplana georgiana*. (For explanation see facing page.)

duct passing anteriorly above the male apparatus and terminating in a rather small sac, the copulatory bursa, situated immediately anterior to the penis bulb, between this and the posterior end of the pharyngeal chamber (fig. 65, *c*). The entire female copulatory apparatus (copulatory bursa, bursal canal, and vagina) is but slightly provided with musculature.

Differential diagnosis.—This species differs from other North American species of *Phagocata* in the asymmetrical penis papilla, expansion of the terminal part of the bursal canal into a vagina, lack of a female antrum, and sharp separation of the vagina from the male antrum.

Locality.—Collected by R. C. Hoffmaster in 1949 and again on Jan. 19, 1951, in Evac Cave near Hillside, Pa. An additional small specimen from Conodoguinet Cave in the same region, also collected in 1949, is presumably the same species although this could not be determined with certainty, as the specimen is immature.

Holotype.—One whole mount deposited in the U. S. National Museum (USNM 24610); also set of transverse sections (4 slides) and set of sagittal sections (3 slides) in this institution.

Remarks.—The occurrence of eyes in a cave planarian is always unexpected but eyes are present in two other North American cave planarians, namely, *Phagocata subterranea* Hyman, 1937, and *Sorocelis americana* Hyman, 1939b. Thus both of our cave planarians that belong to the genus *Phagocata* have retained their eyes and this may indicate only a moderate degree of adaptation of this genus to the cave habitat. It is to be noted, further, that there are white epigean species of *Phagocata* in the United States, so the absence of pigment in the cave species of this genus cannot be regarded as adaptive. *Sorocelis americana* often occurs in epigean habitats, so its retention of eyes is not surprising.

Family Kenkiidae

Sphalloplana georgiana, new species

Figures 65,*d*; 66,*b*; 67,*a*

Material.—Four specimens presented by C. E. Mohr.

Form.—Elongated, slender but less so than the preceding species; narrowed anteriorly with truncate anterior margin bearing a central adhesive organ (fig. 66, *b*); posterior end bluntly pointed; about 8 mm. long.

Color.—White.

Eyes.—Wanting.

General structure.—The histological condition of the specimens, three of which were sectioned, is very bad. The pharynx appears relatively small compared to its size in the preceding species. The digestive diverticula are exceedingly numerous and narrow as indi-

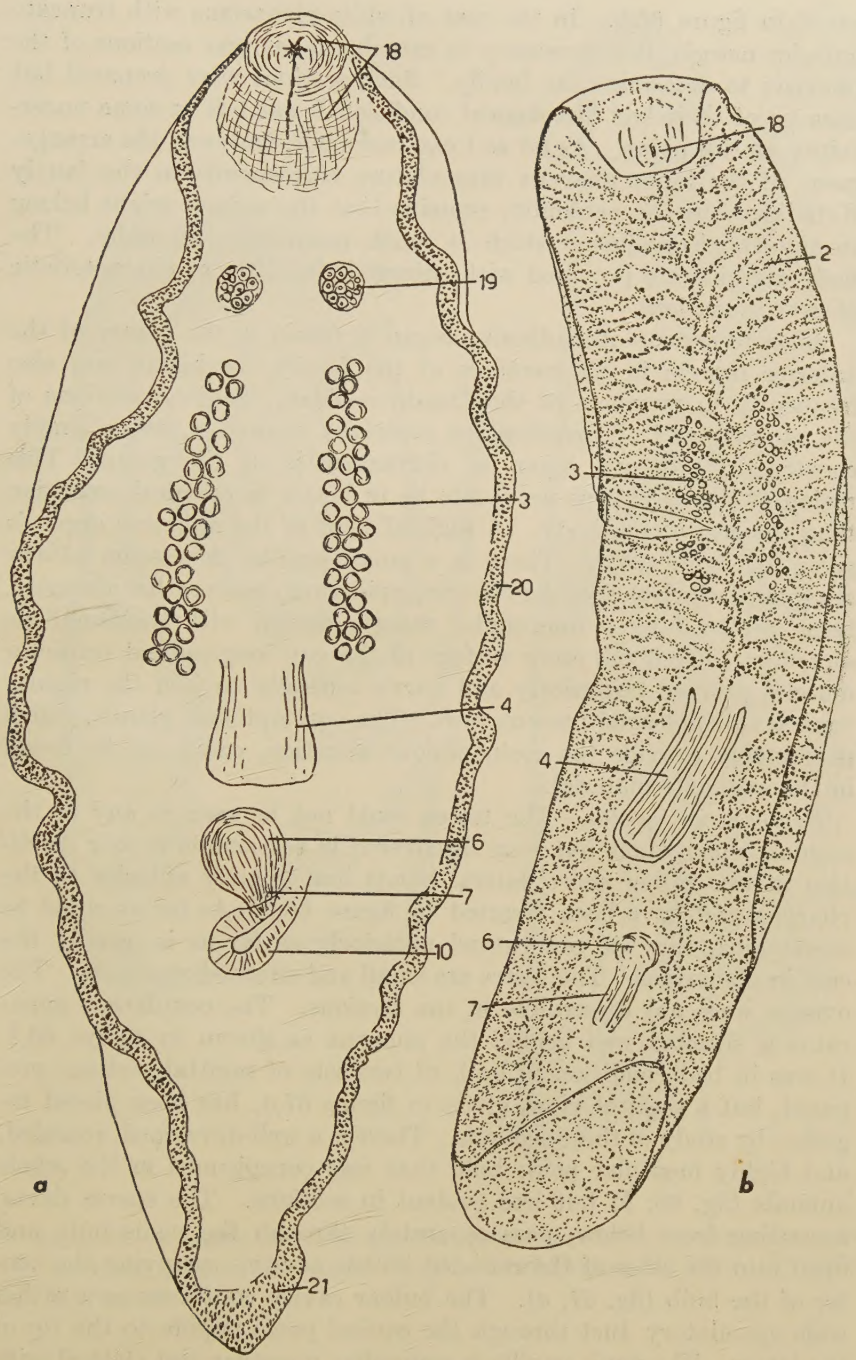

FIGURE 66.—*a*, General view of *Speophila hoffmasteri; b*, general view of *Sphalloplana georgiana*. (For explanation see page 564.)

cated in figure 66,*b*. In the case of white planarians with truncate anterior margin, it is necessary to examine transverse sections of the pharynx to determine the family. Such sections were prepared but because of their bad histological condition I was left in some uncertainty on this point. As far as I can make out, however, the arrangement of the inner pharynx musculature corresponds to the family Kenkiidae but the possibility remains that the animal might belong to the Dendrocoelidae, which it much resembles externally. The body margins are provided with enlarged rhabdites as characteristic of cave planarians.

Adhesive organ.—An adhesive organ is found in the center of the anterior margin in all members of the family Kenkiidae and also frequently in members of the Dendrocoelidae. Sagittal sections of the anterior end of *Sphalloplana georgiana* showed a rather simply constructed adhesive organ as characteristic of the genus. This region of the specimens proved to be in better histological condition than the rest of the body. A sagittal view of the adhesive organ is given in figure 65,*d*. There is a small cuplike depression at the margins of which the regular covering epidermis ceases rather abruptly, being replaced by a noncellular margin dotted with eosinophilous secretion. From the inner surface of the cup longitudinal retractor muscles proceed posteriorly and curve ventrally to join the regular ventral subepidermal musculature. The eosinophilous glands, which presumably provide the eosinophilous secretion, could not be found in the available material.

Reproductive system.—The testes could not be seen in any of the animals when whole but were discovered in sections in a poor condition in two rather short, lateral bands immediately anterior to the pharynx and have been inserted in figure 66,*b*. As far as could be ascertained, they do not extend anteriorly as far as is usually the case in planarians. The testes are small and situated ventrally. The ovaries were not discernible in the sections. The copulatory apparatus is situated well behind the pharynx as shown in figure 66,*b*. It was in bad condition in both of two sets of sagittal sections prepared, but a sagittal view, given in figure 67,*a*, has been pieced together by study of these sections. There is a well-developed, rounded, and highly muscular penis bulb that was conspicuous in the whole animals (fig. 66, *b*) but less evident in sections. The sperm ducts, ascending from below, pass separately through the penis bulb and open into the sides of the rounded bulbar cavity, occupying the center of the bulb (fig. 67, *a*). The bulbar cavity continues as a rather wide ejaculatory duct through the conical penis papilla to the tip of the latter. The penis papilla is somewhat muscular and clothed with a tall epithelium. It lies in a spacious male antrum, into the dorsal wall of which there opens the common ovovitelline duct surrounded

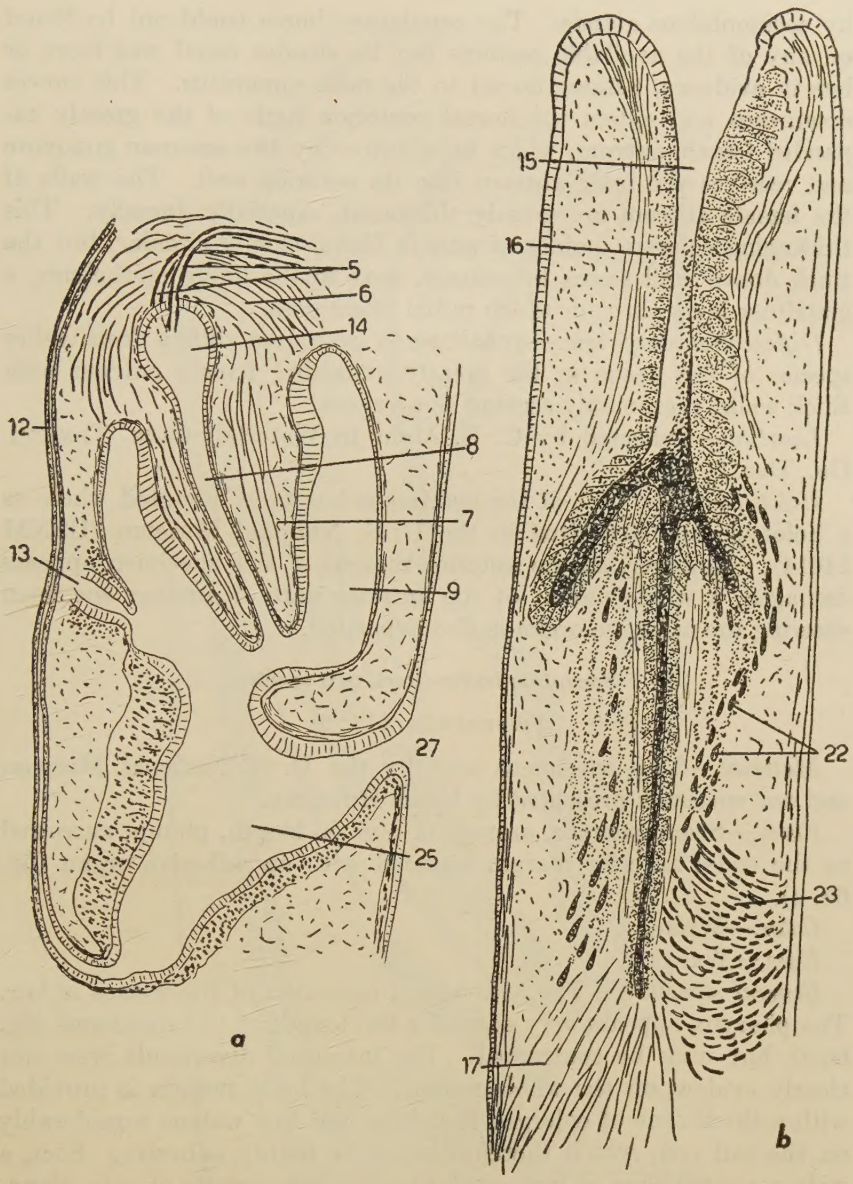

FIGURE 67.—*a*, Sagittal view of the copulatory apparatus of *Sphalloplana georgiana*, anterior end above; *b*, sagittal section of the adhesive organ of *Speophila hoffmasteri*. (For explanation see page 564.)

by eosinophilous glands. The copulatory bursa could not be found on any of the available sections but its slender canal was more or less in evidence, passing dorsal to the male apparatus. This curves downward and enters the dorsal posterior angle of the greatly expanded female antrum, which exits below by the common gonopore and receives the male antrum into its anterior wall. The walls of the female antrum are greatly thickened, especially dorsally. This thickening consists mainly of muscle fibers, chiefly circular, but the thick dorsal wall seems to contain, next to the lining epithelium, a glandular layer through which radial fibers pass.

Differential diagnosis.—*Sphalloplana georgiana* differs from other species of the genus in the greatly expanded female antrum with thick walls, presumably serving as a vagina.

Locality.—Collected by C. E. Mohr in Waterfall Cave, Trenton, Ga., Dec. 8, 1950.

Holotype.—The best of the specimens has been mounted whole as a holotype and deposited in the U. S. National Museum (USNM 24614). However, as the anterior margin of this specimen appears damaged, a whole mount of the anterior part of another specimen showing the adhesive organ is also deposited.

Speophila hoffmasteri, new species

FIGURES 66,*a*; 67,*b*; 68

Material.—Two specimens sent by the U. S. National Museum and one specimen presented by Leslie Hubricht.

Form.—Size moderate, around 11 mm. in length, plump, narrowed at the ends; anterior margin rounded with an adhesive organ (fig. 66, *a*).

Color.—White.

Eyes.—Wanting.

General structure.—The histological condition of the worms is fair. The pharynx appears very short for the length of the specimens (fig. 66,*a*) but may be contracted. The intestinal diverticula were not clearly evident on the whole mount. The body margin is provided with a thick zone of enlarged rhabdites and this widens considerably on the tail end, which therefore must be highly adhesive. Such a wide marginal zone of large rhabdites is characteristic of cave planarians of the family Kenkiidae and gives these worms unusual ability to cling to objects.

Adhesive organ.—At the anterior margin there is a conspicuous and well-developed adhesive organ of the type characteristic of the genus. It is shown in surface view in figure 66,*a*, and in sagittal section in figure 67,*b*. The surface epithelium stops as usual at the lips of the organ which is lined throughout with an indefinite layer filled with

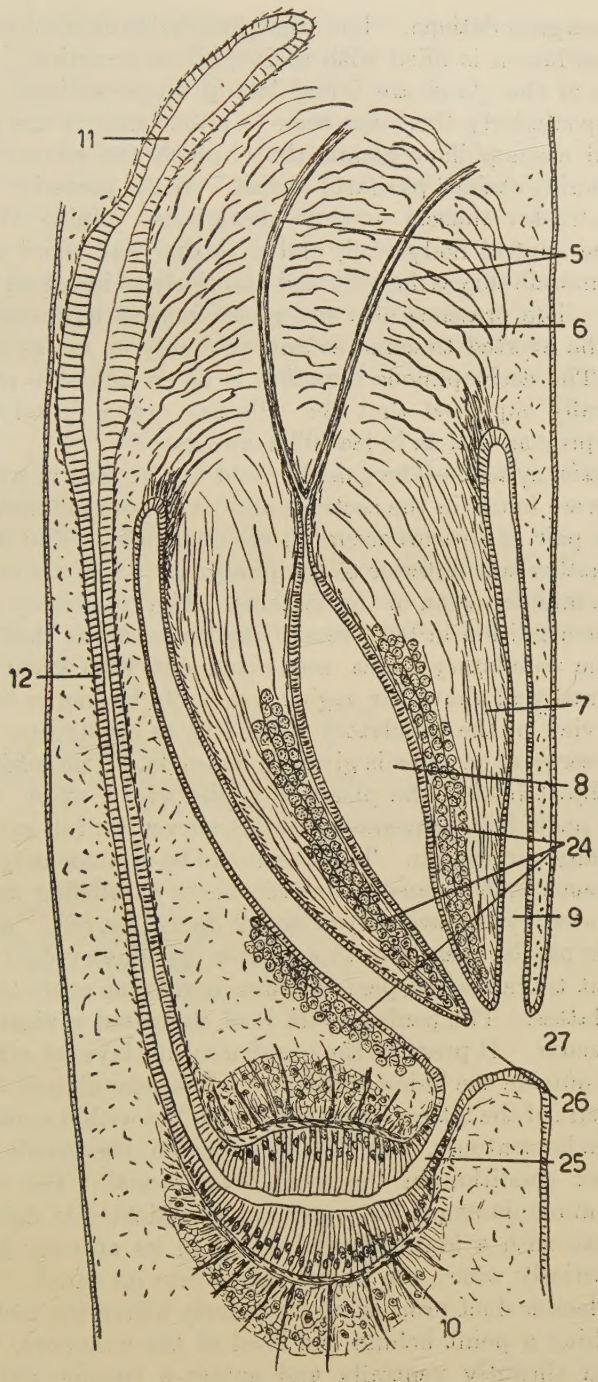

FIGURE 68.—Sagittal view of the copulatory apparatus of *Speophila hoffmasteri*, anterior end above. (For explanation see page 564.)

eosinophilous granulations. The organ has the form of a long tubular gland whose lumen is filled with eosinophilous secretion. At about the middle of the gland are found lateral outpocketings, and from this point posteriorly there are seen to either side of the gland the long-necked eosinophilous glands that furnish the secretion. They appear as darkly stained pyriform bodies. At the posterior end of the gland a retractor muscle extends posteriorly, joining the muscle layer of the ventral body wall, and a thicker and more prominent protractor muscle curves dorsally and anteriorly to insert on the dorsal body wall. The presence of a protractor muscle indicates that the gland can be everted to some extent, probably as far as the lateral pouches. The eosinophilous secretion is of an adhesive nature and it is generally supposed that the adhesive organ functions in the capture of prey as well as in leechlike crawling.

Reproductive system.—The gonads could not be seen in whole specimens but were found in the sections and have been entered on figure 66,*a*. The pair of ovaries occurs in the usual site. The testes form a tract on either side anterior to the pharynx. They are rather large and fill the middle region of the sections. The copulatory apparatus was in poor condition in both sets of sagittal sections that were prepared. The copulatory bursa was made out with great difficulty and the dorsal wall above the vagina was badly broken in both series. A sagittal view of the copulatory apparatus as constructed by study of the two series of sections is given in figure 68. The penis is a conspicuous object behind the pharynx in the whole worm (fig. 66,*a*) but as the penis bulb appears somewhat curved its full extent is not evident in any one section. There seems to be an unusually large and muscular penis bulb formed of muscle fibers paralleling its contours and penetrated by the two narrow sperm ducts (fig. 68). At the base of the penis papilla these join to a narrow ejaculatory duct that soon widens as it traverses the penis papilla, narrowing again towards the tip of the latter. The penis papilla is of elongated conical form and rather muscular. It presents the peculiarity of a layer of cyanophilous gland cells outside the lining epithelium of the ejaculatory duct along the distal part of the latter. The penis bulb lies within a male antrum that follows its contours. As already indicated, the female apparatus was in poor condition in the available material. The copulatory bursa was much damaged but appeared as indicated in figure 68 as a flattened sac with a low epithelial lining in its anterior half, a tall lining posteriorly where the bursa passes into its canal. The latter is a long, slender duct proceeding posteriorly above the male antrum. After reaching a point behind the level of the gonopore, the bursal canal turns abruptly ventrally and enters a conspicuous, rounded vagina that was very evident in the whole specimens (fig. 66,*a*).

The vagina is lined by a very tall epithelium and this is surrounded by a wide halo of what seems to be mesenchyme traversed by radial muscles. Distally the vagina narrows to a short tube that joins the male antrum, forming a very small common antrum that opens below by the common gonopore. The entrance of the ovovitelline duct into the copulatory apparatus could not be found but presumably this duct opens into the roof of the male antrum. In the posterior wall of the male antrum is found an area of cyanophilous glands similar to those surrounding the ejaculatory duct in the penis papilla.

Differential diagnosis.—*Speophila hoffmasteri* is distinguished from the other known species of the genus by the round, thick-walled vagina and the layer of gland tissue in the penis papilla and wall of the male antrum.

Locality.—Collected by R. E. Hoffmaster in Blowing Cave, Pendleton County, W. Va. (no date), and by Leslie Hubricht in Mystic Cave, Pendleton County, W. Va., May 30, 1952.

Holotype.—One whole mount of the better of the Hoffmaster specimens deposited in the U. S. National Museum (USNM 24616); also one set of sagittal sections to show the adhesive organ (5 slides) and one set of sagittal sections of the copulatory region (3 slides) in the same institution.

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